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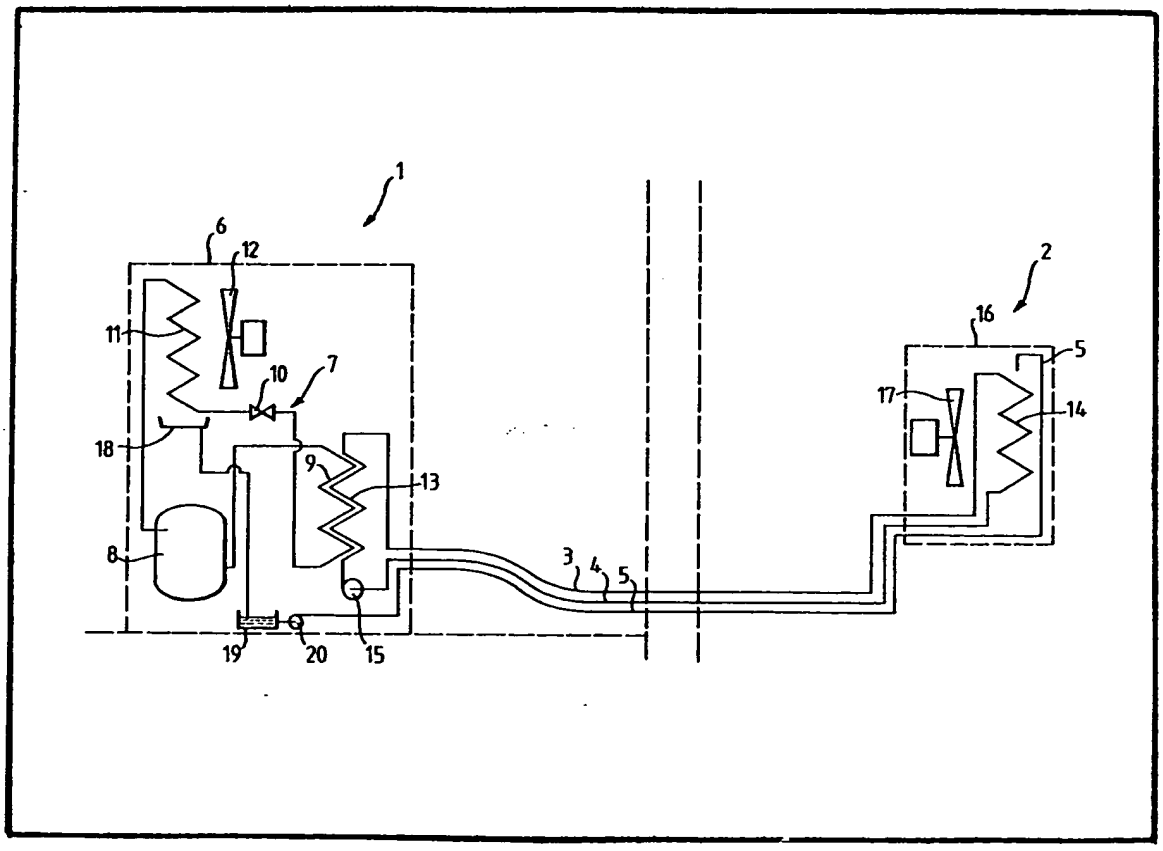
(54) Improvements in air conditioning units

(57) A packaged air conditioner, preferably portable, of the split type comprises two units 1 and 2, the first of which houses a complete refrigeration circuit 7, a fan 12 for drawing air into the first unit 1 and blowing it over the evaporator coil 11 of the refrigeration circuit before discharging it from the unit, and a water jacket coil 13 which surrounds the condenser coil 9 of the refrigeration circuit and which forms part of a water cooling circuit for extracting and dissipating heat from the condenser 9. The second unit 2 of the air conditioner simply houses a cooling coil 14 of the water cooling circuit and a fan 17 for blowing air over the coil 14. The water cooling circuit is completed by a pair of flexible water hoses 3 and 4 extending between the coils 13 and 14 in the first and second units 1 and 2 respectively, and a circulating pump 15. Condensate from evaporator 11 is passed via a hose 5 to coil 14 for evaporation thereby.



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The drawing originally filed was informal and the print here reproduced is taken from a later filed formal copy.

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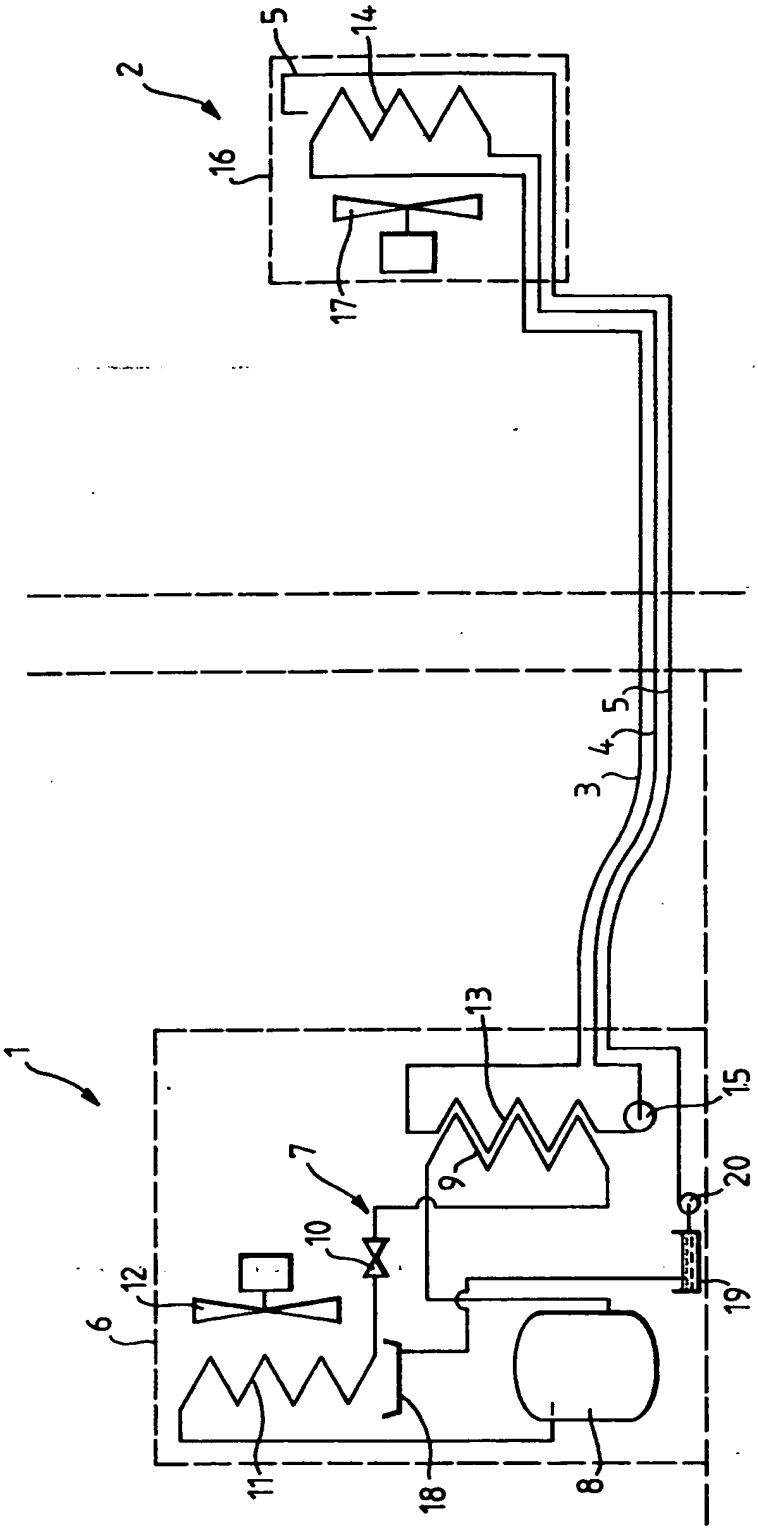

SPECIFICATION

Improvements in small air conditioning units

This invention relates to relatively small air conditioning units which are intended for use in individual rooms in existing buildings, and which are known as packaged air conditioners, and is particularly concerned with portable air conditioners for use on a temporary basis.

Packaged air conditioners basically consist of a refrigeration circuit which operates as a heat pump to remove heat from the room and to dissipate the heat elsewhere, usually outside. The circuit can also be operated in reverse to provide heating for the room if desired, but for the sake of convenience the invention will be described with reference to the cooling function. The air conditioner includes a fan which draws air from the room to lose heat to the evaporator section of the refrigerator circuit before being returned to the room, and the heat taken up by the refrigerant in the circuit is given out in the condenser section of the circuit.

Such air conditioners may be in the form of a single unit which is designed to be installed in a wall or window of the room to be serviced, or may be split into two units, one of which contains the evaporator and the other the condenser, and which are connected by a pair of pipes which carry the refrigerant between the units. This allows the unit which is to be located in the room to be made to look more elegant and perhaps be more conveniently positioned. Also, it can be made relatively large in order to reduce the noise of the air passing through it. The other unit, which will include the compressor of the refrigeration circuit, will be mounted outside the room on a ledge or on the roof of the building.

Even though these packaged air conditioners are comparatively uncomplicated, they do require a significant amount of on site installation work. Either glass or wall has to be cut and bracketing installed in the case of the single units, or pipework has to be run, involving quite sophisticated refrigeration techniques, in the case of split units. Both types could be moved to different locations at a later date but, generally speaking, once installed they are considered to be a permanent fixture.

However, there is an ever increasing demand throughout the world for temporary air conditioning. This is mainly associated with the enormous increase in the use of computers. In operation, computers give off a considerable amount of heat to the surrounding air. If this heat is allowed to build-up, it has an adverse effect on the computer's performance and is extremely uncomfortable for the operator. With larger computer installations therefore, air conditioning is an absolutely essential part of the room's permanent services, and even with the much smaller desk top computers that are becoming more and more available today, some degree of artificial cooling is normally permanently installed. If the permanent air conditioning system should break down, the computer or computers protected thereby cannot be operated for any appreciable length of time without running the risk of breakdown from over heating. Many companies are completely reliant on their computer systems, and any breakdown or reduction in operating capacity can therefore be very costly. Refrigeration repairs to air conditioning systems can be very lengthy, and in these circumstances the availability of some temporary form of air conditioning is essential.

For this purpose portable packaged air conditioners of the split type have been used in which the evaporator unit includes the compressor of the refrigeration circuit and is designed to be located in the room to be serviced, the condenser unit is much smaller and is designed to hang out of a window, stand in a corridor, or be located anywhere the heat which is dissipated is less of a problem, and the refrigeration pipes connecting the two units are flexible. However, because of technical considerations, these flexible refrigeration pipes cannot be more than 2 metres long and must be permanently hermetically connected to the two units. The amount of refrigerant contained in these small hermetic refrigeration circuits is absolutely critical for correct performance of the apparatus, and leaks are simply not allowable. However, because of the type of treatment that the equipment receives and the enormous pressures exerted on these pipes, they do eventually start to leak, usually in about their second year of operation. The replacement of these flexible refrigerant pipes is a lengthy and costly business. Also, the maximum 2 metre spacing between the units permitted by the length of the flexible refrigerant pipes is often quite impractical on site.

According to the present invention we propose a packaged air conditioner of the split type in which one unit includes the complete refrigeration circuit, and the air conditioner has a secondary cooling circuit comprising a heat exchanger in the first unit wherein heat from the condenser of the refrigeration circuit is given up to a coolant in the cooling circuit, means in a second unit for dissipating heat from the coolant, a pair of pipes extending between the two units for conducting the coolant from the heat exchanger to the heat dissipating means and back again, and a pump for pumping the coolant around the secondary cooling circuit.

By making the refrigeration circuit as compact as possible in a single unit and using a secondary cooling circuit for dissipating the heat extracted by the refrigeration circuit, the problems of the existing equipment stemming from the need to have refrigeration pipes extending between the two units are avoided. There is no need for the secondary cooling circuit to be hermetically sealed, nor for the circuit to maintain a fixed amount of coolant, nor for the circuit to be able to withstand extremely high internal pressures. Consequently, without these restraints on the

pipes connecting the two units, the pipes may be made any convenient length. Usually the coolant used will be water, and in the case of portable air conditioners for temporary use the pipes may comprise conventional flexible hoses such as are used in plumbing in domestic washing machines. If the invention is applied to split air conditioners which are intended for permanent installation, the pipes may comprise conventional metal or plastics water pipes. Furthermore, the installation of these pipes can be carried out by a plumber rather than a qualified refrigeration engineer.

Preferably the first unit includes means for collecting condensate from the exterior of the evaporator of the refrigeration circuit, and a pump for pumping the condensate through a third pipe leading to the second unit for disposal of the condensate. This makes the first unit completely independent of external services other than electricity. The means for dissipating heat from the coolant in the second unit of the air conditioner will usually comprise a coil or some other heat exchanger, and a fan for blowing air over the coil, and in this case the condensate delivered to the second unit may be disposed simply by arranging for it to discharge onto the coil so that it is evaporated.

An example of a portable packaged air conditioner in accordance with the present invention is illustrated diagrammatically in the accompanying drawing. As illustrated, the air conditioner comprises two separate units 1 and 2 which are connected by three flexible hose pipes 3, 4 and 5. The first unit has a casing 6 housing a conventional closed refrigeration circuit 7 comprising a compressor 8, a condenser coil 9, an expansion valve 10, and an evaporator coil 11. An electric fan 12 is mounted in the casing 6 for blowing air over the evaporator coil 11, the casing being provided with suitable openings (not shown) for allowing air to be drawn into the casing by the fan 12 and to be discharged from the casing after passing over the evaporator coil 11.

The condenser coil 9 is arranged to be cooled by a water cooling circuit which comprises a jacket coil 13 surrounding the condenser coil 9, a cooling coil 14 mounted in the second unit 2, the flexible pipes 3 and 4 for respectively conducting water from the coil 13 to the coil 14 and back again, and a pump 15 for pumping the water around the circuit. The unit 2 has a casing 16 which houses the cooling coil 14 and also an electric fan 17 for blowing cooling air over the coil 14.

The third flexible pipe 5 extending between the first and second units 1 and 2 serves to carry away from the unit 1 the moisture which, in operation, condenses on the evaporator coil 11 from the air which is blown over it by the fan 12. This condensate collects in a drip tray 18 from which it drains to a sump 19 provided with a float controlled electric pump 20 for periodically delivering the condensate through the pipe 5. In the second unit 2 the pipe 5 is arranged to discharge the condensate so that it falls onto the cooling coil 14 to be evaporated by the heat from the coil and the air blown by the fan 17.

For convenience and ease of operation the pipes 3, 4 and 5 are held together, preferably by being encased in a single sheath, and are also accompanied by electrical leads (not shown) for operating the fan 17 from the electricity supply which, in use, is connected to the first unit 1 to operate the compressor 8, the fan 12, and the pumps 15 and 20. The casing 6 of the unit 1 is mounted on castors (not shown) for easy mobility, and is also provided with brackets (not shown) on which the second unit 2 may be mounted and the sheathed hoses 3, 4 and 5 wound when the air conditioner is not in use.

Claims

1. A packaged air conditioner of the split type comprising first and second units, a refrigeration circuit contained wholly in the first unit, and a secondary cooling circuit which comprises a heat exchanger in the first unit wherein heat from the condenser of the refrigeration circuit is given up to a coolant in the cooling circuit, means in the second unit for dissipating heat from the coolant, a pair of pipes extending between the two units for conducting the coolant from the heat exchanger through the heat dissipating means and back again, and a pump for pumping the coolant around the secondary cooling circuit.

2. An air conditioner according to claim 1, in which the coolant in the secondary cooling circuit is water.

3. An air conditioner according to claim 1 or claim 2, in which the pipes of the secondary cooling circuit extending between the first and second units comprise flexible hoses.

4. An air conditioner according to any one of the preceding claims, in which the means for dissipating heat from the coolant in the second unit comprises a coil through which the coolant is passed, and a fan for blowing air over the coil.

5. An air conditioner according to any one of the preceding claims, in which the first unit includes means for collecting condensate from the exterior of the evaporator of the refrigeration circuit, and a pump for pumping the condensate through a third pipe leading to the second unit for disposal of the condensate.

6. An air conditioner according to claim 5 when dependent upon claim 4, in which the third pipe is arranged to discharge the condensate onto the coil for evaporation.

7. An air conditioner according to claim 1, substantially as described with reference to the accompanying drawing.

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